Rubber Research Scheme

(Ceylon.)

IMPERIAL BUREAU
20 APR. 1928
OF MYCOLOGY

Sixth Report of the Executive Committee

—TO THE—

Members of the Rubber Research Scheme.

PROCEEDINGS DURING THE YEAR

1927.

To be presented at the Ordinary General Meeting

April 20th, 1928.

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Visit of His Excellency the Governor and Lady Stanley to the Rubber Research Scheme Laboratories. November 23rd, 1927.

Rubber Research Scheme (Ceylon).

Peradeniya,
March 20th, 1927.

NOTICE.

Notice is hereby given that the Sixth Ordinary General Meeting of the Rubber Research Scheme (Ceylon) will be held at the Chamber of Commerce Rooms, Colombo, on the 20th of April, 1928, at 11 a.m. for the following purposes:—

1. To receive and consider the Report of the Executive Committee for the year ended December 31st, 1927, and the Annual Statement of Accounts and Balance Sheet as at December 31st, 1927.

2. To receive and consider Reports by the Technical Officers of the Rubber Research Scheme.

3. To receive and consider Report of the London Advisory Committee.

4. To elect Auditors for the coming year and fix their remuneration.

5. To transact any other business that may arise.

By order,

J. MITCHELL,

Organising Secretary.

Committees of the Rubber Research Scheme

as at December 31st, 1927.

EXECUTIVE COMMITTEE.

THE HON'BLE MR. F. A. STOCKDALE, C.B.E. (*Chairman*)
Mr. C. W. BICKMORE.
THE HON'BLE MR. GEO. BROWN.
Mr. A. D. CALLANDER.
„ D. S. CAMERON.
„ C. E. A. DIAS.
„ W. COOMBE.
„ ALLAN COOMBE.
„ J. FARLEY ELFORD.
Mr. CLIFFORD FIGG.
„ G. B. FOOTE.
„ F. H. LAYARD.
„ G. P. MADDEN.
Dr. W. SMALL, M.B.E.
COL. T. Y. WRIGHT.
Mr. J. MITCHELL, (*Secretary*).

TECHNICAL COMMITTEE.

THE HON'BLE MR. F. A. STOCKDALE (*Chairman*).
DR. W. SMALL, Mycologist, Department of Agriculture.
„ J. C. HUTSON, Entomologist, Department of Agriculture.
MR. A. W. R. JOACHIM, Chemist, Department of Agriculture.
MR. H. W. ROY BERTRAND.
„ T. E. H. O'Brien, Chemist of Scheme.
„ R. A. TAYLOR, Physiological Botanist of Scheme.
„ R. K. S. MURRAY, Mycologist of Scheme.
„ J. MITCHELL, Organising Secretary of Scheme (*Secretary*).

LONDON ADVISORY COMMITTEE.

Representatives of Rubber Growers' Association ...	MR. P. J. BURGESS, M.A., F.C.S. (*Chairman*)* MR. H. ERIC MILLER. MR. HERBERT WRIGHT.*
Representatives of Ceylon Planting Interests ...	SIR EDWARD ROSLING.* SIR STANLEY BOIS Mr. G. H. MASEFIELD.*
Representatives of Rubber Manufacturing Companies ...	MR. W. C. SMITH.* MR. W. A. WILLIAMS.* DR. D. F. TWISS, F. I. C., F.I.R.I.*
Representative of the Research Association of British Rubber and Tyre Manufacturers	LT.-COL. J. SEALY CLARKE.*
Representatives of Imperial Institute	LT.-GEN. SIR WILLIAM EURSE.* K.C.B., D.S.O. LT.-COL. SIR DAVID PRAIN.* C.M.G., C.I.E., F.R.S.
Botanists	SIR. J. B. FARMER, D. Sc., L.L.D., F.R.S.* MR. H. N. RIDLEY, C.M.G., F.R.S.*
Secretary	MR. J. A. NELSON, B. Sc.*

*Members of Technical Sub-Committee.

Auditors:
DUNCUM, WATKINS, FORD, & Co. COLOMBO.

Offices:
... RUBBER RESEARCH SCHEME, PERADENIYA,

Bankers:
NATIONAL BANK OF INDIA, LTD.

Research Laboratories:
... CULLODEN ESTATE, NEBODA.

Scientific Staff:

CEYLON.

MR. J. MITCHELL, A. R. C. Sc., Organising Secretary.
MR. T. E. H. O'BRIEN, M. Sc., A. I. C., Chemist.
MR. R. A. TAYLOR, B. Sc., Physiological Botanist.
MR. R. K. S. MURRAY. A. R. C. Sc., Mycologist

LONDON

MR. G. MARTIN, B. Sc., A. I. C., F. I. R. I., Chemist, (Superintendent)
MR. W. S. DAVEY, B. Sc., A. I. C., F. I. R. I., Chemist.
MR. F. L. ELLIOTT, F. I. C., F. I. R. I., Chemist.
MR. L. L. STEWART, Laboratory Assistant.

EXECUTIVE COMMITTEE'S REPORT TO MEMBERS

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GENTLEMEN,

The Executive Committee of the Rubber Research Scheme (Ceylon) submits its report for the year ended December 31st, 1927.

Membership.—A complete list of Members is given in Appendix I of this Report from which it will be noted that at December 31st, 1927 there were 103 Rubber Growers' Association Members and 111 Rubber Research Scheme Members making a total of 214 Members in all. At December 31st. 1926 there were 102 Rubber Growers' Association Members and 109 Rubber Research Members.

Subscriptions.—The subscriptions from Local Subscribers on account of the year ended December 31st. 1927 amounted to Rs. 33,610/37 as compared with Rs. 31,599/84 on account of 1926.

The Ceylon Government Grant for 1927/28 was Rs. 67,500/- which is the same as for 1926/27. The Rubber Growers' Association paid into the London account £2,000 which is the same as for 1926.

Executive Committee.—Messrs. A. F. B. Smeaton and L. M. W. Wilkins resigned and Messrs. Allan Coombe and D. Davidson were appointed to fill these vacancies.

Meetings of the Committee, were held on January 22nd, April 22nd, June 17th, October 21st and December 14th, 1927 and printed copies of the Minutes of these Meetings have been circulated to all Members of the Rubber Research Scheme.

London Advisory Committee.—No changes have taken place in the personnel of the Committee during the year. Meetings were held on January 28th, March 25th, May 27th, July 22nd, and October 28th, 1927 and copies of the Minutes of these Meetings have been supplied to all Members of the Executive Committee.

The Reports of the London Advisory Committee and of the Technical Officers working at the Imperial Institute are attached.

Technical Committee (Ceylon.).—Mr. R. K. S. Murray, A. R. C. Sc., (Mycologist) was appointed to fill the vacancy created by the resignation of Mr. R. H. Stoughton-Harris.

Meetings of this Committee were held on April 22nd, August 16th and October 21st, 1927 and copies of the Minutes of these Meetings have been circulated to Members of all Committees of the Scheme.

Technical Officers.—Mr. R. K. S. Murray, A. R. C. Sc., was appointed Mycologist to fill the vacancy caused by the resignation of Mr. R. H. Stoughton-Harris and took up his duties at the Culloden Laboratories on September 6th, 1927.

Mr. J. Mitchell (Organising Secretary) proceeded on leave to Europe on March 23rd, 1927 and returned on October 3rd, 1927. Mr. Mitchell completed five year's service with the Rubber Research Scheme on March 31st, 1927 and has accepted re-engagement for a further period of two years from October 3rd, 1927.

By permission of the Ceylon Government Mr. Malcolm Park (Assistant Mycologist, Department of Agriculture) was appointed Acting Secretary to the Scheme during Mr. Mitchell's absence.

Mr. R. A. Taylor (Physiological Botanist) proceeded on leave to Europe on September 15th, 1927 and is expected to return on or about April 2nd, 1928. Mr. Taylor completed five year's service on September 15th, 1927, and has accepted re-engagement for a further period of 4 years from the date of his return. Mr. Taylor was appointed the Representative of the Research Scheme at the Imperial Agricultural Conference held in London during October, 1927 and during his leave it has been arranged that he visit the Experimental Stations at Rothamstead and East Maling.

Accounts.—The Audited statement of Accounts and Balance Sheet for the year 1927 is given in Appendix 4 of this Report.

A liberal amount has been written off for depreciation of buildings, apparatus, and furniture.

It will be noted that there has been an excess of income over expenditure of Rs. 27,386/69 as compared with Rs. 30,438/59 for 1926.

The Balance Sheet shows cash on Fixed Deposits, Current Account, in Hand, and in London amounting to Rs. 131,504/57 as compared with Rs. 131,490/69 at the end of 1926. From this balance the sum of Rs. 55,626/18 is earmarked for Sundry Creditors leaving a nett balance in the General Fund of Rs, 75,878/39 to be carried forward to 1928.

During the year a further sum of Rs. 20,788/42 has been spent on the Experiment Station, Nivitigalakele, the development account for which now stands at Rs. 29,497/77.

Laboratories.—As stated in the Annual Report for 1926 an extension to the Chemical Laboratory has become necessary and a contract has now been given out for this work. The building has been kept in good repair and the equipment has been kept up to the full requirements of the Staff.

Bungalows.—These have been kept in good repair and the water supplies thereto are in good order.

During 1928 it is proposed to erect bungalows on Culloden Estate for the Subordinate Staff.

Rubber Experiment Station.—During the year the Research Scheme has secured the further area of 13 acres referred to in the Annual Report for 1926 and now has 63 acres for development. Up to the end of the year approximately 30 acres have been opened on the contour platform terracing system and are fully planted with stocks of known parentage. The remaining portion of the land has been felled and will be planted during 1928 with seed at stake and with stumps of known parentage. During Mr. Taylor's absence on leave Mr. Murray has been placed in charge of the Station. A cart road approximately 1½ miles long has been laid down from the main Matugama-Agalawatte Road and easy access to the Experiment Station will be possible during 1928.

During the year 1023 buddings have been carried out of which 246 have proved successful. Marcots have been taken from 77 of the successfully budded stumps. In addition 30 budded plants from Peradeniya and 18 plants budded with material from Java have been successfully established.

On November 23rd, His Excellency the Governor and Lady Stanley paid a visit to the Experiment Station and subsequently inspected the Laboratories on Culloden Estate.

Agricultural Conference.—At the Agricultural Conference held at Peradeniya in March, Mr. Mitchell read a paper on "Brown Bast and its Treatment" and Mr. Taylor a paper on "The Importance of Bark Examinations in the Selection of Prospective Mother Trees." These papers were published in the Local Press and in the Conference Number of the Tropical Agriculturist published in April.

PROGRESS OF WORK.

1.—ORGANISING SECRETARY.

(*a*) **Secretarial.**—Mr. J. Mitchell continued his duties as General Secretary of the Research Scheme and as Secretary of the Executive and Technical Committees from January 1st, to March 23rd, and from October 3rd, to December 31st. The intervening period was spent on leave in Europe and Mr. Malcolm Park (Assistant Mycologist, Department of Agriculture) was appointed Acting Secretary during that period. All correspondence was kept up to date and a considerable amount of routine work was efficiently carried out by the Secretarial Staff.

(*b*) **Visiting.**—In addition to the Secretarial work Mr. Mitchell paid visits to 36 estates and issued reports thereon to the Agents and to the Superintendents of the Estates visited. Mr. Mitchell's report is attached and it will be noted that with certain exceptions the general condition of estates in Ceylon continues to be satisfactory. There has been a continued extension of the use of Vigna (Dolichos Hosei) as a check against soil erosion and in several districts its growth is most satisfactory. Brown Bast is prevalent on most estates and on some estates, particularly in dry districts, the number of trees affected is high. The scraping method of treatment, which was detailed by Mr. Mitchell before the Agricultural Conference held in March appears to be proving quite satisfactory and recoveries subsequent to treatment have been good.

There has been a recurrence of Oidium leaf disease on most of the estates where it occurred in 1925 and 1926 and reports have been received from other estates indicating that the disease is becoming more widespread. It is considered that spraying would be ineffective as a preventive of this disease and that the application of nitrogenous manures offers the most likely means of mitigating the effects of this disease.

2.—CHEMIST.

Mr. T. E. H. O'Brien continued to serve as Chemist to the Scheme. The following briefly indicates the work that he has had in hand during the year:—

(*a*) **Samples for Imperial Institute.**—The preparation of samples of rubber for testing purposes by the Research Scheme Chemists working at the Imperial Institute has been undertaken and the investigations on these samples are referred to in the Report from the London Advisory Committee.

(*b*) **Factory Efficiency.**—A careful enquiry is being made into all the factors which have a bearing on the efficient and economical working of rubber factories and a considerable amount of valuable data has been collected.

(*c*) **Glass Hydrometers.**—The glass hydrometer for latex which was placed on the market early in the year has proved very satisfactory and an increasing number of estates are using this instrument in preference to the Brass Metrolac. Experiments have been carried out for the purpose of devising a suitable hydrometer for Formic Acid and a specification has now been drawn up for an instrument which will satisfy requirements.

(*d*) **Smoke Houses.**—Experiments have been continued with a view to improving the efficiency of smoke houses particularly in relation to the consumption of firewood. Considerable progress has been made in this matter and proposals are now under consideration for testing on a larger scale certain of the conclusions arrived at.

(*e*) **Miscellaneous Investigations.**

1. **Effect of Disinfectants on Scrap Rubber.**—An enquiry into this matter has shown that tackiness may result when disinfectants are applied on the tapping cut before the removal of the scrap.

2. **Mercurophon and Sal Hycol.**—An enquiry has been made as to the efficacy of these substances to prevent the development of mould on rubber. The results were not satisfactory and these substances are not regarded as equal to Paranitrophenol in this respect.

3 **Paranitrophenol in Crepe Rubber.**—Tests have shown that dipping crepe rubber in paranitrophenol solution causes slight discoloration and this method is not recommended. Preliminary experiments indicate that if .025% solution of paranitrophenol is added to the latex spotting will be prevented and no deleterious effect on the colour will result.

4. **Packing of Sheet Rubber.**—Further tests have been carried out to determine the best method of packing sheet rubber. It is considered desirable to pack the rubber immediately after removal from the smoke house.

5. **Rice Cunjee in Latex.**—This frequent complaint has been investigated and it has been found that such contamination can be detected by adding N/100 iodine solution to an equal volume of latex.

3.—PHYSIOLOGICAL BOTANIST.

Mr. R. A. Taylor continued his duties as Physiological Botanist and as Officer-in-charge of the Experiment Station, Nivitigalakele. The following indicates the work which has been undertaken during the year:—

(*a*) **Experiment Station.**—The area cleared and planted is now approximately 30 acres and the remaining 33 acres has been felled ready for planting during 1928.

A good cart road from the main Matugama-Agalawatte road has been completed and easy access to the Experiment Station will be possible during 1928.

The whole area has been opened on the contour platform terrace method and has been planted with seeds and stumps of known parentage. Budwood has been secured from the highest yielders at Heneratgoda and Peradeniya and from certain estates but up to the present time the percentage of successes has been below expectations and it will be necessary to rebud the failures during 1928.

(*b*) **Study of Brown Bast.**—Experimental work has been continued to test certain of the theories connected with the incidence and development of Brown Bast but it has not been possible to arrive at any definite conclusions. A report on the work done by Mr. Taylor during the past 5 years is in course of preparation.

(*c*) **Study of Characters of High Yielding Trees.**—The study of the relationships between the yield of a tree and the other vegetative characters has been continued and much valuable data has been collected. Arising out of this work it is anticipated that a method may be evolved whereby the yielding capacity of a tree can be determined at an earlier age than is possible at the present time.

(*d*) **Budding of Rubber and Selection.**—Interest in this subject has been well maintained throughout the year and a large number of enquiries for advice and information have been received and dealt with. Yield records from a number of the highest yielding trees in Ceylon have been kept, bark samples examined, and their characteristics registered. These high yielders are being used as bud-mother-trees for testing on the Experiment Station.

(*e*) **Manuring Experiments.**—The manuring experimeuts commenced in February 1926 have been continued and the yields, girth measurements, and bark structure of the trees have been recorded. It is proposed to make a complete analysis of the records on the termination of the 3rd year of the experiment, *i.e.* March 1929.

(*f*) **Change-over Tapping Experiment.**—This experiment has been continued but up to the present time no significant difference in latex yield has been observed between the change-over and the non-change-over plots.

(*g*) **Spraying of Rubber.**—Tests have been made with a power driven pump received from Messrs. Drake & Fletcher, Ltd. While the working costs of this are lower than for the hand power pump the general results were not more satisfactory than for the hand pump and it would appear that a sprayer entirely suited to Ceylon conditions still remains to be discovered.

4.—MYCOLOGIST.

Mr. R. K. S. Murray was appointed to fill the vacancy created by the resignation of Mr. R. H. Stoughton-Harris and arrived in Ceylon on September 5th. He proceeded direct to Culloden Estate and on the departure of Mr. R. A. Taylor on home leave was placed in

charge of the Experiment Station, Nivitigalakele. Reference to the progress on this Station has been made in the Physiological Botanist's Report.

A programme of research work for Mr. Murray has been drawn up by the Technical Committee of the Research Scheme. This includes an enquiry into the occurrence and significance of *Rhizoctonia bataticola* as a root disease of rubber. Further research work is to be carried out in connection with the Phytophthora diseases of rubber and special attention is to be given to the subject of the prevention and treatment of Bark Rot. The Committee considered that further enquiry into the occurrence of Oidium leaf-fall disease was necessary and this matter is to receive Mr. Murray's close attention during the coming year.

Research Work at the Imperial Institute.—A full report on the work carried out at the Imperial Institute is attached. The London Advisory Committee has forwarded the following reports:—

(*a*) Report on samples of Plantation Rubber prepared in connection with experiments on Variability. (Rubber Research Scheme Quarterly Circular No. 1, 1927).

(*b*) Report on samples prepared with Formic Acid and Acetic Acid and the suitablity of rubber prepared with Formic Acid for the manufacture of dipped goods.

(*c*) On the possible contamination of latex with Copper Compounds as a result of spraying the trees with Bordeaux Mixture. (Rubber Research Scheme, Quarterly Circular No. 2, 1927).

(*d*) On the Variability of Ceylon Estate Grades (Rubber Research Scheme Bulletin No. 47).

(*e*) On the Effect of Smoking on the Plasticity of Sheet Rubber.

(*f*) On Air-Dried Sheet with the appearance of Smoked Sheet.

(*g*) " Revertex " (Rubber Research Scheme, Quarterly Circular No. 4, 1927).

The principal problem dealt with during the year was the cause of variation in the plasticity of plantation rubber and considerable progress towards the elucidation of this problem has been made. The principal factor appears to be the extent of maturation of the rubber and this matter is being inquired into.

The study of the value of serum substances in retarding the deterioration of vulcanised rubber has been continued and it has been found that the addition of alkalis in conjunction with serum prolongs the life of the product.

An examination of a series of commercial rubbers collected from a number of Ceylon estates did not show the high standard of uniformity in time of vulcanisation desired by manufacturers but they compared favourably with similar rubbers from Malaya and Java.

PUBLICATIONS.

Rubber Research Scheme Bulletins.—The following Research Scheme Bulletins have been issued during the year:—

No. 45. The Efficiency of Disinfectants and Fungicides.

No. 46. The Control of Bark Rot by Disinfectants.

No. 47. Report on Variability of Ceylon Estate Grades.

Rubber Research Scheme Quarterly Circulars.—Circulars dealing with questions of current interest to the rubber planting Industry have been published at quarterly intervals and appear to be much appreciated. These have been issued through the *Tropical Agriculturist* and thereby have been made available to the whole of the subscribers to that publication and through the press to the general public. The following are the chief matters which have been dealt with in these quarterly communications and issued in the form of circulars:—

1. Notes on visits to some Rubber Factories and Research Laboratories in England.
2. Natural Immunity of Rubber Trees to Bark Rot.
3. Report on samples of Plantation Rubber prepared in connection with Experiments on Variability.
4. Explanatory Notes on Vulcanisation testing of Rubber.
5. The Effect on Yield of Manuring Rubber with Nitrate of Soda.
6. Possible contamination of Latex with Copper Compounds as a result of spraying the trees with Bordeaux Mixture.
7. Oidium leaf disease of Hevea.
8. Notes on Rubber Manufacture.
9. Report on Revertex.
10. Notes on Brown Bast and its treatment.

Rubber Growers' Association Bulletins.—All the Bulletins published by the Rubber Growers' Association during 1927, have been received and issued to all estates which do not receive them direct from London.

Meetings.—The thanks of the Rubber Research Scheme are due to the Chamber of Commerce, Colombo, for the free use of their rooms for the various Meetings of the Committees of the Scheme.

Adopted by the Executive Committee at its Meeting held in Colombo on January 20th, 1928.

(Signed) F. A. STOCKDALE,
Chairman,
Executive Committee,
Rubber Research Scheme (*Ceylon*).

RUBBER RESEARCH SCHEME,
PERADENIYA,
16th, January, 1928.

ORGANISING SECRETARY'S REPORT ON VISITS TO ESTATES.

———:o:———

The writer proceeded on leave on March 23rd, returning to Ceylon on October 3rd, so the present report refers more particularly to observations made during the first and last 3 months of the year. During the intervening period visits to estates were paid by Mr. T. E. H. O'Brien and Mr. R. A. Taylor and observations recorded by them have been noted in drawing up this general report.

The characteristic symptoms of the various diseases met with have been carefully described and methods of treatment fully demonstrated for the benefit of the Staff on each estate. In addition, the many problems connected with the cultivation of rubber and of manufacture have been enquired into and suggestions made for dealing with these. In all cases a report has been furnished for the general information and guidance of the Superintendents. Agents, and Directors of the Companies concerned.

The following comments indicate the conclusions arrived at as a result of these visits and represent the writer's opinion of the general condition of rubber estates in Ceylon during 1927.

DISEASES.

1. **Root Diseases.**—Until the position of *Rhizoctonia bataticola* as a possible primary factor in the causation of root diseases of rubber has been definitely established the writer proposes to deal with this section under the old well-known headings.

(*a*) **Fomes lignosus.**—This disease has been kept well under control and on most estates visited is giving very little anxiety. There is, however, too much digging of trenches without at the same time taking the precaution to dig over the affected areas thoroughly and to remove affected material. Trenching alone is not a sufficient means of successfully treating this disease.

(*b*) **Fomes lamaoensis.**—(Brown Root Disease). This disease has been observed on most of the estates visited but only as isolated cases and no serious outbreaks have been recorded.

(*c*) **Ustulina zonata.**—This disease has been responsible for many deaths in the older rubber areas and a large number of cases in the early stages of attack have been treated. There does not appear to be any desire on the part of Superintendents to undertake the task of filling the holes produced by this disease and very little work of this description has been done.

(*d*) **Poria hypobrunnea.**—This disease has not been observed on any of the estates visited nor has it been reported to the writer.

(*e*) **Sphaerostilbe repens.**—This disease was observed on two of the estates visited and in each case the area was subject to flooding from the river adjacent. No other cases have been reported.

(*f*) **Rhizoctonia bataticola.**—Very little interest in the occurrence of this disease has been shown by the majority of Superintendents of estates. The divergent views of Mycologists who have expressed themselves on the matter have created an impression amongst rubber planters that the subject is of academic interest rather than one of practical importance.

2. STEM DISEASES.

(*a*) **Stripe Canker or Bark Rot.**—There has been a marked improvement in this connection throughout all Districts which is attributable to the more systematic preventive painting with disinfectants which is being done on estates. Where attacks have taken place it has usually been found that the necessary precautions have been neglected.

(*b*) **Patch Canker.**—(Claret Coloured). This disease has given very little trouble on any estate and has now ceased to give more than occasional anxiety to Superintendents of estates.

(*c*) **Die-back.**—Cases of die-back involving the death of the tree have been few and these occurrences have been of a spasmodic nature. No outbreak of importance has been reported.

(*d*) **Pink Disease (Corticium Salmonicolor.)**—A few cases of this disease have been noted in young clearings but no serious outbreak has occurred.

(*e*) **Brown Bast.**—At the Agricultural Conference held at Peradeniya in March a paper was read by the writer on " Brown Bast and its Treatment " and a number of estates have taken a more serious interest in the matter of treatment on the lines advised. The disease continues to be serious in the Kurunegala, Matale and Uva Districts but under the conditions of restricted output of rubber is not increasing to any marked extent in the other Districts of the Island. The results of the treatment have proved surprisingly good and estates are strongly advised to take up the treatment without delay so that the disease can be kept under complete control.

3.—LEAF DISEASES.

(*a*) **Secondary leaf-fall.**—There has been a distinct improvement in this connection throughout all affected districts. It would appear that the manuring of rubber which has been practised during the past two or three years is having a beneficial effect on the general health of the trees and that the evil effects of the leaf-fall have been reduced to an appreciable extent.

(*b*) **Oidium Leaf-fall.**—There has, on the other hand, been an increase in the number of estates which have reported an outbreak of this disease and the area affected is much larger than in 1926. It is considered that spraying would be ineffecttve as a preventive of the spread of this disease and that the application of nitrogenous manures offers the most likely means of mitigating its effects.

GENERAL PROBLEMS.

1. **Manufacture.**—Estates are continuing to use Formic Acid in the place of Acetic Acid and with satisfactory results.

Paranitrophenol is continuing to give satisfaction as a preventive of mould on sheet rubber and it is anticipated that a method will shortly be devised for preventing spots in crepe rubber by the use of this chemical.

2. **Budding of Rubber.**—Interest in this subject has been well maintained and a considerable amount of advisory work in this connection has been carried out. There is every reason to believe that Ceylon has now taken up this matter with all seriousness and is anxious to make up for lost time.

3. **Manuring.** Most estates have carried out manuring programmes and it is considered that distinct improvement in the general condition of the estates has resulted. This is shown more particularly in the reduced severity of secondary leaf-fall and the minimised attack of Oidium on areas which have received generous applications of nitrogenous manures.

4. **Cover Crops.**—Practically every estate is now growing some cover crop as a preventive of soil erosion and for the purpose of improving the general condition of the soils. Excellent covers of Vigna (*Dolichos Hosei*) have been established over large areas and Boga Medelloa (*Tephrosia Candida*) is proving very successful along the terraces throughout many estates. Unfortunately, the snail pest has appeared in the Vigna and is doing considerable damage and up to the present time no satisfactory means of eradicating this pest has been devised.

(Signed) J. MITCHELL,
Organising Secretary.

RUBBER RESEARCH SCHEME (CEYLON).
PERADENIYA.
10th February, 1928.

CHEMIST'S REPORT FOR 1927.

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During the year under review attention has been chiefly directed to practical problems of factory procedure and efficiency. The following is a summary of work carried out:—

1. FACTORY EFFICIENCY.

A series of experiments is in progress on the subject of the efficiency of crepe rollers. To anyone acquainted with local factories it is noticeable that there are big variations regarding many points connected with crepe rolling, and the object of the investigation is to determine what methods of procedure will result in the most efficient and economical working.

In measuring the output of a roller it is essential to know the thicknees of the rubber coming from the machine at the time the test is made. Owing to the unevenness of crepe rubber it is inconvenient to make direct measurements of thickness so to overcome this difficulty samples of crepe rubber taken during the test have been carefully weighed and measured and a figure for thickness has been calculated in terms of weight per square foot. This method is equally applicable to tests with grooved or smooth rollers and enables direct comparisons to be made of machines in different factories.

Grooved rollers.—With regard to maceration of coagulum in grooved rollers tests showed that "slip" is not an important factor. The chief factors which regulate output in this case are A) speed of rollers B) thickness at which maceration is carried out C) number of times of rolling.

The present tendency in Ceylon factories is to speed up machinery and in one case this has been raised as high as 35 revolutions per minute. From his observations, the writer concludes that this speed is too high to enable the opertor to feed the machine efficiently, and that fast rolling has less effect on the rubber. At present it is considered that 20—22 revs. per minute is a suitable speed for a macerating roller. Apart from the output of rubber it is obvious that a high speed involves a disproportionate increase in power consumption and wear and tear of machinery.

It has been found that the thickness of rubber fed in to a smooth crepe roller does not influence the output of lace crepe, so in order to secure the maximum output from the grooved roller the aim should be to roll the rubber to the maximum thickness which can be fed into the smooth roller without tearing. Five rollings in the grooved rollers is considered to be sufficient.

Smooth rollers.—In this case the most important factor governing output is the "slip" of the wet rubber in the rolls. This is not surprising to anyone who has tried to walk on a wet floor in crepe soled shoes, but it is surprising to find that the "slip" may amount to as much as 150%, or in other words that the surface of the roller moves 3 feet to produce 1 foot of crepe. This factor depends partially on the speed of operation and also

on the texture of the roller surface. Experiments are in progress to determine the extent to which "slip" can be reduced by marking smooth rollers with diagonal hair-line grooving.

It is hoped to publish a full report of the experiments in the course of the next few months.

2. CURING OF SHEET RUBBER.

Shortage of firewood for smoking is becoming a serious factor on many estates and experiments are in progress with a view to reducing the quantity of wood required for smoking sheet rubber or of eliminating it altogether.

In a large scale experiment it was demonstrated that the problems of production of heat and smoke in the smokehouse can be dealt with separately. In this experiment smoke was generated by slow combustion of wood in an iron drum, and heat was produced by means of charcoal brasiers. It is evident that the heat could equally well be provided by means of steam or hot air pipes, using coal or liquid fuel as the heating medium. In this way smoked sheet of normal quality can be prepared with a firewood consumption of 1/4—1/5 of present requirements. It is hoped that in the near future one or two estate smokehouses will be fitted with experimental heating installations.

Samples of airdried sheet (containing paranitrophenol to prevent mould) were prepared and forwarded to the Imperial Institute for examination. They were favourably reported on both as regards appearance and quality. If these results are confirmed it is hoped that a market for unsmoked sheet could be developed and the use of firewood eliminated.

Further samples of airdried sheet in which the colour of smoked sheet was produced by addition of a chemical to the latex, were examined at the Imperial Institute, and were found to be similar to smoked sheet in appearance and quality. This provides another means of eliminating firewood in sheet manufacture but is not at present recommended by the Research Scheme.

3.—FORMIC ACID AS A COAGULANT.

The use of Formic acid in Ceylon has not increased during the past year and this can largely be attributed to rumours which were in circulation to the effect that its use leads to the production of streaky or dark coloured crepe. It has been further stated that formic acid rubber was not suitable for certain manufacturing processes.

Two chests of blanket crepe rubber made from one batch of latex and coagulated with acetic acid and formic acid respectively were prepared and forwarded to the Imperial Institute for examination. Both samples were excellent in appearance with a slight advantage in favour of the formic acid sample. These samples were sent to Manufacturers who carried out dipping trials and they concluded that teats made from formic acid rubber had a slight greenish tint not present in those from acetic acid rubber. This difference in colour could not be detected by members of the Technical Committee of the Research Scheme who recently examined the samples.

In view of the fact that the manufacture of transparent goods absorbs no more than 1/1,000 part of the world's output of plantation rubber this result can hardly be regarded as a legitimate objection to the use of formic acid in general.

The Research Scheme recommends adoption of formic acid as a measure of economy, and it may be mentioned that it is now used on 90% of the estates in Java, and is largely used in Malaya and Sumatra.

4.—GLASS HYDROMETERS FOR LATEX.

The glass hydrometer for latex developed by the Research Scheme was placed on the market early in the year. Arrangements were made for Messrs. Walker Sons & Co,, Ltd., Colombo to carry stocks and to supply estates either direct or through other Agents. It has been ascertained that sales during the year have been very satisfactory.

The hydrometers are in use on numerous estates, and are considered by most users to be more satisfactory than the brass instruments. The only difficulty which has arisen is that in a few cases the block marking of the scale has worn off and this defect has been reported to the manufacturers. The scale can easily be re-marked with bitumenous solution and details will be given by the writer to anyone interested.

5.—GLASS HYDROMETERS FOR FORMIC ACID.

A hydrometer for testing formic acid has been developed which gives a direct reading as percentage strength of the acid. Tests on various samples of commercial formic acid showed that the reading was within 0.5% of the actual strength as determined by analysis. It is proposed to arrange for a supply of these hydrometers to be available for sale during 1928.

6.—PACKING OF SHEET RUBBER.

In R. R. S. Bulletin No. 43 "Smoking of smoked sheet in relation to mould prevention," the conclusion was reached that sheet packed direct from the smokehouse is less liable to become mouldy than sheet which has been hung up or stocked for some time before packing.

A factory test on this subject was made some time ago but when the rubber was examined in London by a Representative of the Research Scheme no difference was found in the degree of resistance to mould. It was therefore decided to make further tests and factory samples have again been dispatched for examination in London. The results are not yet available but a number of tests have been made locally.

In these experiments sheets taken direct from the smokehouse were divided into two portions one of which was hung up for two weeks and the other packed direct in a chest of rubber. At the end of two weeks the samples were tested for moisture and resistance to mould growth. The following figures are the average of tests on six different estates.

Moisture.

Moisture in sheet on removal from smokehouse	...	0.24 %
Moisture in sheet after being packed for 14 days	...	0.33 %
Moisture in sheet after being hung up for 14 days	...	0.70 %

Resistance to mould growth.

(Samples inoculated with mould and kept in a moist atmosphere for 14 days. The figure given represents the proportion of the surface covered with mould at the end of the test.)

Sheet packed direct from smokehouse	8.8 %
Sheet hung up for 14 days	40.5 %

These results amply justify the conclusion previously reached that sheet rubber should be packed on the day of removal from the smokehouse. It is possible that the advantages of this procedure are lost by the time the rubber arrives in London, owing to gradual absorption of moisture and loss of smoke through the chest, but there is no doubt that the chief danger of mould development is during the period that the sheet remains in a hot moist climate. If it can be protected from mould during this period it is unlikely that it will develop during subsequent storage in a temperate climate.

7.—PARA NITROPHENOL FOR PREVENTION OF SPOTS IN CREPE.

The use of para nitrophenol for the prevention of mould on smoked sheet is now established on numerous estates and gives good results when the treatment is properly carried out. Experiments are in progress to determine whether para nitrophenol can be satisfactorily applied in crepe manufacture for the prevention of spotting during drying and storage.

It was found that soaking lace crepe in a 0.1 % solution of para nitrophenol effectively prevents spotting but causes a slight discoloration of the finished crepe. Soaking in a 0.01% solution prevents spotting except under severe laboratory tests but even at this low concentration there is a slight discoloration of the crepe.

Tests showed that para nitrophenol can be incorporated in the latex in the proportion 1 part para nitrophenol to 4,000 parts dry rubber without any deleterious effect on the colour of the crepe. This treatment was not sufficient to prevent the gradual development of spots under a severe laboratory test but it is considered sufficiently effective to prevent spotting under estate conditions of manufacture and storage.

It remains to be seen whether the treatment can be applied to all latex and at all seasons without causing discoloration, but anyone who is troubled with spots in crepe is advised to experiment with this method of control. The cost is practically nil (1/20 cent per lb.), and if the correct proportion of para nitrophenol is mixed in with each carboy of undiluted acid the risk of mistakes is reduced to a minimum.

8.—SAMPLES FOR THE IMPERIAL INSTITUTE.

During the year 110 samples of approximating 750 lbs. weight were prepared and forwarded to the Imperial Institute for examination.

9.—MISCELLANEOUS INVESTIGATIONS.

1. **Effect of disinfectants on crepe rubber.**—It has been found that scrap rubber which has come in contact with " tar acid " disinfectants (as used in the control of bark rot) is liable to become tacky when exposed to sunlight. It was concluded that the scrap should be removed from the tree before the application of the disinfectant.

2. **Mercurophen and Sal Hycol as Mould preventives.**—Tests were carried out which showed that these substances do not effectively prevent the growth of mould on sheet under laboratory conditions. They have a certain inhibitory effect but are less efficient than para nitrophenol.

3. **Rice "Cunjee" in latex.**—In reply to an estate enquiry experiments were carried out to devise a means of detecting rice "cunjee" in latex. It was shown that this can be done satisfactorily by mixing a small quantity of latex with an equal bulk of N/100 Iodine solution. If "cunjee" is present in an appreciable quantity a blue coloration develops.

10.—VISITS AND ADVICE TO ESTATES.

Visits were made to 10 estates for the purpose of advising on manufacture, and full reports were furnished for the information of the Superintendents and Agents.

Each year shows an increase in the number of enquiries from estates, and this was larger than usual this year owing to the absence of the Organising Secretary on furlough.

The writer takes the opportunity of thanking Superintendents who have kindly given facilities for experiments on roller efficiency and other subjects. Without their assistance and interest many of the experiments could not have been carried out.

11.—REPORTS PUBLISHED DURING 1927.

1. Notes on visits to Rubber factories and Research Laboratories in England (R. Rs. 1st Quarterly Circular 1927.)

2. Explanatory Notes on vulcanisation testing of Rubber (R. Rs. 2nd Quarterly Circular 1927.)

3. Notes on Rubber Manufacture (R. Rs. 3rd Ouarterly Circular 1927.)

12.—SUMMARY OF WEATHER RECORDS AT CULLODEN LABORATORIES.

	1927.		1926.	
Rainfall	152.22	ins. ...	161.2	ins.
Highest monthly rainfall ...	42.46	„ ...	33.81	„
Highest daily rainfall	9.725	„ ...	8.30	„
Highest shade temperature recorded (day)	93.3° F.	...	95.7° F.	
Lowest shade temperature recorded (day)	76.8° F.	...	76.8° F.	
Lowest shade temperature recorded (night)	66.4° F.	...	66.6° F.	

(Signed) T. E. H. O'BRIEN,
Chemist,
Rubber Research Scheme.

RESERRCH SCHEME LABORATORIES,
CULLODEN ESTATE,
NEBODA.
31st January, 1928.

PHYSIOLOGICAL BOTANIST'S REPORT FOR 1927.

1. **Experiment Station.**—During the year a further 16 acreas of jungle has been cleared at Nivitigalakele. This area was opened on the contour system with rows in one direction, and was planted out in October with seedlings in baskets. The areas between the platforms have been sown with mixed seed of various species of Leguminosae used as cover crops.

A certain amount of difficulty was experienced in getting rid of the heavier timber owing to the absence of a cart road. A cart road is, however, now under construction linking the Station with the main Matugama-Agalawatte road and it is anticipated that this will be completed early in 1928.

The Lines and Office buildings which were under construction at the end of 1926 have been satisfactorily completed. A further line of six rooms has also been built.

The trees in the 1926 clearing have shown fairly good growth. Repeated attempts to establish Vigna (*Dolichos Hosei*) by cuttings have met with little success. Hedges of *Tephrosia candida* and *Clitoria cajanifolia* have been established and provide a certain amount of cover. The areas between the platforms were sown during November and December with mixed seed of various cover crops and these are showing promising growth.

About 400 stumps were budded during May but owing, it is believed, to the extremely wet weather experienced just after the bandages were removed the number of successes was comparatively small. Rebudding was carried out in August—September, and again in November and the percentage of successes has been somewhat higher.

Nineteen budded stumps, budded with material imported by Mr. C. E. A. Dias from Java, were received during the year from Peradeniya; all but one are doing well. 49 budded stumps were received from Peradeniya in November of which 30 are healthy. Of the remainder either the bud or the whole stump has died.

The nursery which was planted in 1926 has been manured but has not done well probably owing to the very poor quality of the soil. It is noticeable here, however, that much better growth is shown by the offspring of certain trees.

Of the first seventy successfnl buddings the stocks were marcotted off instead of being cut off in the usual way. This operation was attended with complete success and it would appear that young plants respond more readily to this method of vegetative propagation than branches of older trees. It is intended to marcot the budded shoots produced by these plants and so obtain as three separate plants the stock, the scion, and the budded stock. A study of the characters of the each will be made when the plants are older and it is hoped that some light may be thrown on the question of the effect of stock on scion. The parentage on the one side of all the stocks is known and measurements of growth of the budded shoots are to be made at six monthly intervals. All the possible combinations of stocks and scions have been made.

The remainder of the land, amounting to about 30 acres, has been felled and will be known as the 1928 clearing. Sufficient selected seed to plant this area has been set out in the nurseries.

Part of the deniya land was drained early in the year, and 2,000 good stumps have been planted. 5 ft. by 5 ft. This will constitute the budwood nursery. The remaining portions of deniya have since been drained.

The Experiment Station was handed over to Mr. R. K. S. Murray on September 12th, 1927.

2. **Brown Bast.**—The work done on Brown Bast has not been extensive but three small experiments have been carried out. An effort has been made to discover in what way " over-tapping " affects the tree, and to determine if there is some definite upsetting of the physiology of the tree. Other writers on this subject have suggested various theories but none of these provide proof of a definite cause. The work is still in progress and a full report is now in the course of preporation. It may be said however that fairly strong evidence has heen obtained to show that there is no direct relationship between the incidence of Brown Bast and the amount of latex withdrawn.

3. **Study of Characters of High Yielding Trees.**—A further study was made of the relationship between Yield and other Characters of the tree and a method of estimating the Yielding power by examination of these characters has been evolved. The result is not entirely satisfactory but the method is more exact than the mere counting of Latex Vessel Rows. Application of the method to young trees has not yet been done on any extensive scale but it is thought that further investigation may lead to a method of obtaining some estimate of the value of a tree at a much earlier age than is possible at present.

4. **Budding of Rubber and Selection.**—Great intersst has been shown in the question of Budding and Selection and the correspondence dealt with on this subject has much increased. A number of estates have been visited in connection with Yield Recording, pruning of mother trees and budding. and numerous bark samples have been examined. The possibility of replacing poor trees by higher yielding budded trees is being studied. It consists of felling the tree at ground level and budding on to the trunk directly or on to the base of one of the adventitious shoots sent out. The points about which information are required are the possibility of healing over the large cut surfaces, and the strength of the point of union between the stump and the budded shoot. Thirty rather poor trees have been felled for this purpose. To date only two have sent out shoots and none have yet been budded.

When the mother trees now being tested out have eventually been graded according to the yielding power of their budded offspring, there will probably be a large demand for budwood from the best of these and the best methods for increasing the amount of budwood available are being studied. During the year attempts have been made to propagate Hevea vegetatively by cuttings. It is known that this can be done with young material but the results obtained from branches of old trees have shown that this is not suitable material. It is intended to experiment with pollarded shoots.

5. **Manuring Experiment.**—The manuring experiment on Arapolakande Estate has been continued. Manures were applied in February and records of Yield have been kept. It is intended to make a full analysis of the figures at the end of 1928, that is, after the experiment has run three years.

6. **Mycological Work.**—During the period that the Mycological post was vacant diseased specimens submitted for examination were dealt with.

7. **Spraying of Rubber.**—Spraying of Rubber as a preventative of secondary leaf-fall has not become a general practice, and very few estates carried out any spraying work during 1927. A demonstration of the working of the Drake and Fletcher machine and the method of spraying was given on one estate. Tests have been made with a power driven pump designed by Messrs. Drake and Fletcher and it would appear that the power driven outfit was slightly cheaper to operate. It is considered, however, that, unless leaf-fall becomes a much more serious disease, spraying is not an economic proposition in Ceylon. A large part of the cost of the operation is due to the necessity of climbing up and down the trees and handling the hose and nozzles.

Since the departure of the Organising Secretary on furlough 19 estates have been visited in his stead, and reports have been sent to the Superintendents and Agents. Much of this work was in connection with root disease but Brown Bast received a considerable amount of attention and in one case defects in manufacture were dealt with during the visit.

8. **Change-over Tapping Experiment.**—The "Change-Over" tapping experiment has been continued and the records to date show that there is no significant difference in Yield between the "Change-over" and "Non-Change-Over" plots. Measurements of bark renewal have not been taken during the year.

(Signed.) R. A. TAYLOR,
Physiological Botanist.

RUBBER RESEARCH SCHEME LABORATORIES,
CULLODODN ESTATE,
NEBODA.
28th February, 1928.

MYCOLOGIST'S REPORT FOR 1927.

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The Mycologist arrived in the Colony on September 5th 1927, and proceeded direct to Culloden Estate to take up his duties in the laboratories.

1. **Experiment Station, Nivitigalakele**—The Experiment Station was taken over from Mr. R. A. Taylor on September 12th, and the progress made on the Station during the last four months of the year has been incorporated in the Physiological Botanist's Report for 1927.

2. Manuring and Brown Bast Experiments which were being carried out by the Physiological Botanist have been supervised during his absence.

3. **Bark Samples.**—A number of bark samples have been received from various Estates and have been examined and reported on. Correspondence in connection with budding and selection has been dealt with.

4. **Spots in Crepe.**—In order to test the efficiency of para nitrophenol as a preventative of spotting inoculations of crepe rubber with organisms causing spots have been made.

Inoculations of samples of smoked sheet with Moulds have also been made in connection with the Chemist's Experiments on Mould Resistance. (See Chemist's Report).

5. **Programme of Work for 1928.**—At a meeting of a Sub-Committee (Technical Committee) held at Peradeniya in November, a programme of work was drawn up for the Mycologist under the following headings:—

(*a*) **Root Diseases.**—It was considered that a study should be made of the fungus *Rhizoctonia bataticola* and of its relation to the other fungi which are regarded as responsible for root diseases of rubber.

Work in this connection has up to the present time been confined to a systematic search for *Rhizoctonia bataticola* in the roots of diseased trees.

(*b*) **Phytophthora Diseases.**—It is intended to carry out a mycological study of the species of Phytophthora which are believed to cause disease in rubber. Field experiments on the treatment of bark rot are also under consideration particular attention being paid to the time of application of disinfectants.

(*c*) **Oidium Leaf-fall.**—A study of the occurrence, spread, and possibilities of control of this disease has been started.

6. **Diseased Specimens.**—Diseased specimens of rubber and of cover crops submitted for examination have been reported on.

7. **Visits to Estates.**—Six estates have been visited in an advisory capacity and reports have been furnished where desired.

(Signed) R. K. S. MURRAY,
Mycologist, Rubber Research Scheme.

RESEARCH LABORATORIES
CULLODEN, NEBODA.
February 23rd, 1928.

REPORT OF THE LONDON ADVISORY COMMITTEE FOR 1927.

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Membership of Committee.—A list of the Members is given on the cover page. No alterations occurred during the year.

Mr. Burgess, the Chairman, whilst on a visit to the East called at Ceylon and discussed several matters relating to the work of the Scheme with the Chairman and Members of the Ceylon Executive Committee. During his absence Sir Edward Rosling acted as Chairman of the London Committee and Technical Sub-Committee.

Meetings of the Committee.—Both the Committee and Technical Sub-Committee held five meetings during the year. The Committee and Technical Sub-Committee had the benefit of the assistance of Mr. James Mitchell, A.R.C.S., Organising Secretary in Ceylon, and Mr. R. A. Taylor, B. Sc., Physiological Botanist, who attended meetings whilst in this country and discussed with the Committee and the staff in London various questions concerning the investigations in progress. Arrangements were made for Mr. Taylor to represent the Scheme at the Imperial Agricultural Research Conference held in London in October, 1927.

Finance.—The expenditure incurred by the London Committee was £2,665 13s. 11d., which included £284 8s. 11d. in respect of apparatus etc., purchased on behalf of the Ceylon Committee. At 31st December, 1927 there was an unexpended balance in London £87 12s. 10d.

Staff.—No alterations occurred in the technical staff which consists of Mr. G. Martin, B. Sc., A.I.C. (Superintendent), Mr. W. S. Davey, B. Sc., A.I.C., Mr. F. L. Elliott, F.I.C., and Mr. L. L. Stewart.

During the year Messrs. Martin, Davey and Elliott were elected Fellows of the Institution of the Rubber Industry.

As a result of further enquiries to find a Mycologist for service in Ceylon to fill the vacancy caused by the resignation of Mr. R. H. Stoughton-Harris, Mr. R. K. S. Murray, A.R.C.S., was recommended by the Committee and was appointed by the Under Secretary of State for the Colonies.

Rubber Exhibition.—Illustrations of the work of the Scheme were displayed in the Rubber Exhibition held at the Imperial Institute in December, 1927, and technical enquiries arising out of the Exhibition were dealt with by the staff of the Scheme.

Investigations.—The principal problem dealt with during the year was the cause of variation in the plasticity of plantation rubber. Considerable progress was made and reports were sent to Ceylon on a number of investigations. The results were reviewed in a paper read by Mr. Elliott at the Birmingham Section of the Institution of the Rubber

Industry on the 8th December, 1927, and are to be published in the Transactions of the Institution. So far the principal factor affecting variation which has been observed is the extent of maturation and it is accordingly proposed to devote special attention to a detailed investigation of this subject in 1928.

The study of the value of the serum substances in retarding the deterioration (perishing) of vulcanised rubber was continued. It was found that the addition of alkalis in conjunction with serum prolongs the life of the product considerably and a patent has been applied for through the Rubber Growers' Association so that, should it be possible to develop the process commercially, the benefits may be available for the industry generally.

A series of commercial rubbers collected from a number of estates did not exhibit the high standard of uniformity in time of vulcanisation desired by some manufacturers but the results did not compare unfavourably with those published for estate rubbers from Malaya and Java. The degree of uniformity which could be obtained on rubbber estates by preparation under carefully standardised conditions is now under investigation in consultation with the Central Rubber Station, Java.

In connection with the examination of a set of samples prepared by the staff in Ceylon to imitate the appearance of smoked sheet without smoking, in view of the shortage of firewood, the Committee were impressed with the control sample which contained darkening agent, but to which paranitrophenol had been added for preventing the development of mould. The question as to whether this form of rubber will be acceptable to manufacturers is under discussion with the Research Association of British Rubber and Tyre Manufacturers.

Further information regarding the investigations carried out are given in the Appendix to this report.

The following Reports were forwarded to Ceylon during the year:

Variability in time of vulcanisation of samples prepared by different methods employed in Ceylon (Research Scheme Quarterly Circular No. 1. 1927).

Possible contamination of latex with copper compounds as a result of spraying the trees with Bordeaux Mixture (Research Scheme Quarterly Circular No. 2, 1927).

Variability of Ceylon estate grades (Bulletin No. 47).

Air-dried sheet with the appearance of smoked sheet (separately circulated to Members)

Effect on plasticity of drying sheet under different conditions.

Suitability of rubber prepared with formic acid for the manufacture of dipped goods.

Conference with Dr. de Vries.—During the year very useful conferences were held with Dr. de Vries, the Director of the Central Rubber Station, Java, who visited the Institute and discussed in detail a number important problems relating to rubber research

and also the principal work in progress at the two laboratories. Arrangements were made with him for closer co-operation and for an extension of the present duplicate investigations of methods of testing. Useful suggestions were made by Dr. de Vries as to the types of investigations which can better be carried out in this country than in the tropics and vice versa. A number of investigations were carried out in co-operation with the Research Association of British Rubber and Tyre Manufacturers.

(Signed) P. J. BURGESS,

Chairman.

IMPERIAL INSTITUTE,
SOUTH KENSINGTON,
LONDON.

January, 1928.

APPENDIX TO ANNUAL REPORT OF THE LONDON COMMITTEE FOR, 1927.

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1. **Variability of Ceylon Estate Grades.**—During the year a report was sent to Ceylon on a set of thirty-nine samples of smoked sheet, air-dried and machine-dried crepe collected from different estates in order to ascertain the extent of the variability in rubber prepared commercially in Ceylon and to obtain information likely to be of value in planning future investigations. The samples were examined for variability in the following respects:—

(*a*) Plasticity.

(*b*) Time of vulcanisation in a rubber-sulphur mixing (90.10).

(*c*) Mechanical properties in a mixing containing zinc oxide and diphenylguanidine, the latter being an accelerator of vulcanisation.

The vulcanising properties in the rubber-sulphur mixing were fairly uniform, the extent of the variation being similar to that observed by Dr. de Vries in the case of an extensive series of estate samples in Java. The only recent figures for Malayan estate rubber available for comparison relate to a collection of samples for competition at a local exhibition, and these show somewhat less variation.

Only the machine-dried crepe from Ceylon satisfies the high standard of uniformity desired by some manufacturers, and further experiments have accordingly been arranged with a view to determining the degree of uniformity in estate rubbers which could be obtained by preparation under carefully standardised conditions from latex bulked from a wide area.

The results obtained in the plasticity tests and in the vulcanisation tests in the zinc-oxide-accelerator mixing are discussed in the following paragraphs dealing generally with the work on plasticity and on organic accelerators and variability.

2. **Plasticity of Rubber.**—In view of the extended application of organic accelerators variations in time of vulcanisation are not now regarded as of so much practical importance as hitherto and manufacturers state that variations in the plasticity of rubber present great difficulties in factory procedure. Consequently the work in London has been largely devoted for some time to this subject.

In the plasticity tests carried out on the sets of estate grades referred to above the statements made by manufacturers were confirmed. Considerable variations were found in the products of different estates, the softest sample being three times as plastic as the hardest sample. The smoked sheets were more variable than the crepes, and the air-dried crepes more variable than the machine-dried crepes.

The results were also of considerable interest as they suggested lines on which further investigations to determine the cause of this variation could most usefully be made. For example, the smoked sheets and machine-dried crepes were on the average a little more plastic than the air-dried crepes suggesting that temperature of drying may be a

factor affecting plasticity. Arrangements were accordingly made for the preparation of sets of samples to study the effect of drying sheet (1) in smoke for various periods and (2) in air at different temperatures. The smoked sheets were more plastic than the air-dried sheets but the experiment on the drying of sheet at different temperatures was inconclusive and is being repeated.

There was a distinct correlation between the times of vulcanisation of the estate grades in the rubber-sulphur mixing and their plasticity. Experiments to determine the effect of maturing the coagulum for different periods were accordingly carried out. On the whole the plasticity of the rubber decreased as the period of maturing increased but the differences between these samples were not sufficiently marked to indicate that variations of plasticity are due principally to the extent of maturation. These tests may not, however, be comparable with those on the estates, as the former were examined six months after preparation (which is the standard practice of the Imperial Institute) and the latter, not until after two years, as the methods of measuring plasticity were not determined until some time after their arrival. It has since been shown by Dr. de Vries that the plasticity of raw rubber may change on keeping and it is now proposed to test samples after storing them at known temperatures for various periods.

Plasticity tests were also carried out on several sets of samples prepared in connection with other investigations but the variations observed gave no indication of the causes of the differences in commercial samples.

The work during the year confirmed the opinion expressed in the Report for 1926 that the plasticity of a rubber-sulphur mixing bears a definite relation to that of the corresponding masticated rubber. Determinations of the plasticity of a rubber-sulphur mixing are therefore now only made in special cases and this has enabled a greatly increased number of samples to be dealt with. No other change in the method of testing was made, but in view of the difficulty experienced in obtaining uniform duplicate results it is proposed to pay special attention to methods of mastication during 1928.

Messrs. Martin and Elliott visited the factory of the Dunlop Rubber Company and discussed with the scientific staff the methods of testing employed and the steps taken to control variations in plasticity. Much valuable information was obtained which will be of assistance in future investigations of this Scheme.

5. **Organic Accelerators and Variability.**—Since 1922 routine vulcanisation tests have been carried out at the Imperial Institute not only in a rubber-sulphur mixing 90.10) but also in other mixings containing in addition zinc oxide and an organic accelerator. The results obtained with the estate grades referred to in paragraph 1 and with other first grade rubbers during this period show that the variations observed in the accelerator mixings are much less than those in the rubber-sulphur mixing.

As a result of experiments in another type of accelerator mixing the chief chemist of the Goodyear Tire and Rubber Company * concluded that the use of accelerators did not necessarily reduce and might even increase variability. Further investigations at the

* R. P. Dinsmore and A. O. Zimmerman (Ind. and Eng. Chem. 18, 1926, 144.)

Imperial Institute have recently shown that the effect of accelerators depends largely on the type of mixing employed and as those selected by Dinsmore for his experiments would be suitable for soft rubber goods it is proposed to examine a variety of samples in this mixing with a view to determining the cause of the variations.

4. **Ageing properties of vulcanised rubber.**—Following the practice adopted last year, artificial ageing tests in a rubber-sulphur mixing were carried out wherever possible on all samples received for report on their general quality. In addition special attention was given to a further investigation of the effect of the addition of serum substances. The principal conclusions from the year's work are:

(*a*) Serum substances are not rendered less effective in retarding deterioration in tensile strength by the removal of the proteins and are more effective when freed from the acid used for coagulation.

(*b*) The addition of serum substances in conjunction with alkalis not only results in the tensile strength being maintained for a still longer period but also prevents much of the decrease in elongation which accompanies the use of serum alone, and in this respect is superier to a number of commercial antioxidants. The investigation is being extended to technical mixings and the effect of serum treated in a variety of ways is being studied.

The superiority of fine hard Para over plantation rubber which was observed in previous artificial ageing tests in a rubber-sulphur mixing (see Report for 1926) was not considered to be sufficiently marked to justify the preference of certain manufacturers for this product in the manufacture of elastic thread and tape. Further experiments on samples under tension (the condition under which tape and thread are used) indicate that fine hard Para is undoubtedly superior, and at the first opportunity tests will be made to determine the reason for this. The possibility of reducing this difference in quality by the use of suitable antioxidants will also be investigated.

Considerable time is required for the determination of the ageing properties of each sample by the present method in which the samples are tested after heating in a current of air in an oven at 70.0 for various periods. With a view to expediting the tests experiments are being made to determine whether equally satisfactory results can be obtained by another method now largely used in America which, it is stated, furnishes the same information in less than half the time. Attention is also being given to a revised method of preparing test pieces which it is hoped will not only increase the output of work but also furnish more accurate results.

5. **Suitability for the manufacture of dipped goods of rubber prepared from latex coagulated with formic acid.**—In consequence of complaints as to the lack of transparency of dipped goods received in Ceylon since the introduction of formic acid as a coagulant, samples of crepe prepared with formic and acetic acids were forwarded to the Imperial Institute for comparative examination. The samples were of similar quality and no differences between them were observed in dipping tests, Arrangements were accordingly made with the Research Association of British Rubber and Tyre Manufacturers for

technical trials to be carried out by three manufacturers, but as the results were contradictory the Committee obtained two cases of rubber from Ceylon for investigation on a larger scale by two of the manufacturers. They reported that teats produced from the formic acid sample showed a very faint greenish shade when compared with those from the acetic acid sample, and in reply to enquiries as to the importance of this difference in colour the Association stated that, while it was too slight to be noticed by the actual user of the goods, it may be sufficiently obvious to provide a ground for complaint on the part of the factor and distributor. After careful consideration of the matter following inspection of the teats made in the trials, the Committee came to the conclusion that no further action by the Scheme was necessary at the present time.

6. **Sheet dried in air without smoking.**—In order to overcome difficulties arising out of the increasing shortage of firewood, experiments were conducted by the staff in Ceylon with a view to ascertaining if sheet rubber with the appearance of smoked sheet could be made without the use of smoke. In connection with these experiments a series of samples was prepared from latex to which had been added (1) paranitrophenol to prevent the development of mould and (2) darkening agents to imitate the appearance of smoked sheet. The results of their examination at the Imperial Institute showed that they were all of satisfactory quality except the one containing phenol as a darkening agent. This had poor ageing qualities. The Committee were impressed with the control sample of air-dried sheet containing paranitrophenol but no darkening agent. It was of very good appearance and had satisfactory plasticising, vulcanising and ageing properties and they consider that it might be preferable to market rubber in this form than to imitate smoked sheet. Consultations with representatives of manufacturers are in progress with a view to obtaining their views on the subject.

7. **Effect of differences in the dilution of the latex and in the nature and strength of the coagulant.**—During the discussion last year with Mr. O'Brien regarding his new programme of work it was pointed out that although variations in the degree of dilution of latex and in the strength of acid do not have an important effect on the properties of rubber when the coagulant is acetic acid, more marked differences may occur when formic acid or sodium silicofluoride are used. At the request of the Technical Sub-Committee Mr. O'Brien undertook to arrange for the preparation of a series of appropriate samples for investigation. In tests in a rubber-sulphur mixing and in an accelerator-zinc-oxide mixing the quality of the rubber was not appreciably affected by considerable increases over the normal strength of coagulant nor by moderate changes in the dilution of the latex. A report on this investigation was in preparation at the close of the year for despatch to Ceylon.

8. **Bordeaux mixture.**—In continuation of previous experiments (see Report for 1926) which showed that the addition of even a trace of Bordeaux Mixture to latex caused the vulcanised product to perish quickly, tests were carried out on a further set of samples prepared in Ceylon to determine whether spraying the crown of the trees in the usual way is likely to introduce sufficient copper into the latex to cause deterioration of the rubber

on keeping. No such deterioration was observed in the samples obtained from latex collected at various intervals within a few days after spraying, but it cannot be too strongly emphasised that great care should be exercised in preparing rubber after spraying operations, as the presence of even traces of copper in rubber is detrimental. While the rubber is in the raw state the effect may not become obvious for many months but nevertheless all articles manufactured from the rubber will quickly perish.

9. **Revertex.**—Arrangements were made with the Research Association of British Rubber and Tyre Manufacturers for a joint investigation of Revertex, a concentrated latex which it is suggested might with advantage take the place of crepe and sheet as the raw material in the rubber manufacturing industry.

Although no definite conclusions regarding the relative cost of working can be drawn from these small-scale experiments it appears unlikely that the process would prove more economical for large-scale operations than the present methods of dealing with plantation rubber. The only advantage definitely established for this product over ordinary forms of rubber was its excellent behaviour in artificial ageing tests and it remains to be seen whether this would be maintained under ordinary conditions of use. Equally excellent results were obtained in artificial ageing tests on plantation rubber to which serum and alkali were added on the mixing rolls (see paragraph 4 above).

Further tests to determine the suitability of Revertex for special purposes were under discussion with the Research Association of British Rubber and Tyre Manufacturers at the close of the year.

(Signed) P. J. BURGESS,
Chairman.

IMPERIAL INSTITUTE,
SOUTH KENSINGTON, S.W., 7.

January, 1928.

APPENDIX No. 1.

LIST OF MEMBERS.

Members of Rubber Growers' Association.

Aboyne-Clyde Rubber Estates of Ceylon, Ltd.
Alliance Tea Company of Ceylon, Ltd.
Alluta Rubber and Produce Co., Ltd.
Amalgamated Tea Estates Co., Ltd.
Anglo-American Direct Tea Trading Co., Ltd.
Anglo-Ceylon and General Estates Co., Ltd.
Associated Tea Estates of Ceylon, Ltd.
Bandarapola Ceylon Co., Ltd.
Beau Sejour Rubber Co., Ltd.
Beverley Tea and Rubber Estates, Ltd.
Caledonian (Ceylon) Tea and Rubber Estates, Ltd.
Carolina Tea Company of Ceylon, Ltd.
Central Province Ceylon Tea Co., Ltd.
Ceylon Consolidated Estates (1920), Ltd.
Ceylon (Para) Rubber Co., Ltd.
Ceylon Proprietary Tea Estates Co., Ltd.
Ceylon Rubber Co., Ltd.
Ceylon Tea Plantations Co., Ltd.
Ceylon Timber and Rubber Syndicate, Ltd,
Colombo Commercial Co., Ltd
Consolidated Estates Co., Ltd.
Consolidated Tea and Lands Co., Ltd.
Dalkeith (Ceylon) Rubber Estates, Ltd.
Dangan Rubber Estates, Ltd.
Deviturai Rubber and Tea Estates, Co., Ltd.
Dickella (Ceylon) Rubber Estates, Ltd.
Dimbula Valley (Ceylon) Tea Co., Ltd.
Doloswella Rubber and Tea Estates, Ltd.
Doone Vale (Ceylon) Rubber Co., Ltd.
Doranakande Rubber Estates, Ltd.
Eastern Produce and Estates Co., Ltd.
East India and Ceylon Tea Co., Ltd.
Ederapolla Tea Co., of Ceylon Ltd.
Elmshurst (Ceylon) Tea and Rubber Co., Ltd.
Elston Estates Company of Ceylon, Ltd.
Frocester Estate Rubber Co., Ltd.
Galaha Ceylon Tea Estates and Agency Co., Ltd.
Galphele Tea and Rubber Estates, Ltd.
General Ceylon Rubber and Tea Estates, Ltd.
Glen Rubber and Tea Co., Ltd.
Glendon Rubber Co., Ltd.
Gonagama Rubber Co., (Ceylon), Ltd.
Govinna Rubber Co., Ltd.
Grand Central (Ceylon) Rubber Estates, Ltd.
Hanipha Ceylon Tea and Rubber Co., Ltd.
Hanwella Rubber Estates, Ltd.
Hewagam Rubber Co., Ltd.
Higgoda Rubber Estates, Ltd.
Honiton Rubber Co., Ltd.
Hunasgeria Tea Co., Ltd.
Igalkande Rubber and Tea Estates, Ltd.
Imperial Ceylon Tea Estates, Ltd.
Kandy Rubber and Tea Estates, Ltd.
Kelani Valley Rubber Estates, Ltd.
Kepitigalla Rubber Estates, Ltd.
Kintyre Tea Estates Co., Ltd.
Knavesmire Estates Co., Ltd.
Kudaganga Rubber Co., (of Ceylon), Ltd.
Kurunegala Rubber Co., Ltd.
Lanka Rubber Co., Ltd.
Lanka Plantations Co., Ltd.
Lavant Rubber and Tea Co., Ltd.
Lochnagar (Ceylon) Produce Co., Ltd.
Lowmont Estates Co., Ltd.
Lunuva(Ceylon) Tea and Rubber Estates, Ltd.
Mahawale Rubber and Tea Co., Ltd.
Mapalagama Rubber Estates, Ltd.
Mirishena (Kalutara) Rubber Co., Ltd.
Monerakelle Rubber Estates, Ltd.
Nagolle (Ceylon) Rubber and Tea Plantations Ltd.
Nahalma Tea Estates Co., Ltd.
Narangoda Rubber Co., Ltd.
Nayabedde Estates Co., Ltd.
Neboda (Ceylon) Rubber and Tea Estates, Ltd.
Ouvah Ceylon Estates, Ltd.
Panagula Rubber Co., Ltd.
Panawal Tea Co., Ltd.
Panawatte Tea and Rubber Estates, Ltd.
Pantiya Tea and Rubber Co., Ltd.
Parambe Rubber and Tea Co., of Ceylon, Ltd.
Pelmadulla Rubber Co., Ltd.
Palmadulla Valley Tea and Rubber Co., Ltd.
Pimbura Rubber Co., Ltd.
Pindenioya Rubber and Tea Estates, Ltd.
Pitakande Tea Co., of Ceylon, Ltd.
P. P. K. (Ceylon) Rubber Estates, Ltd.
Ragalla Tea Estates, Ltd.
Remuna Rubber Co., Ltd.
Rosehaugh (Ceylon) Rubber Co., Ltd.
Rubber Estates of Bentota, Ltd.
Rubber Estates of Ceylon, Ltd.
Saffragam Rubber and Tea Co. of Ceylon, Ltd.
St. George Rubber Estates, Ltd.
Standard Tea Co., of Ceylon, Ltd.
Sunnygama Co., Ltd.
Telbedde Ceylon Estates, Ltd.
Tempo Tea and Rubber Co., Ltd.
The Ceylon (Bibile) Rubber Estates, Ltd.
United Planters' Co., of Ceylon Ltd.
Vogan Tea Co., of Ceylon, Ltd.
Woodend (Kelani Valley Ceylon) Rubber and Tea Co., Ltd.
Yataderiya Rubber and Tea Co., Ltd.
Yatiyantota Ceylon Tea Co., Ltd.

LOCAL SUBSCRIBERS—(Companies.)

Ankande Estate Co.. of Ceylon, Ltd.
Apthorpe Estates, Ltd.
Aranayaka Rubber Co., Ltd.
Atherfield Tea and Rubber Co., Ltd.
Avington Tea and Rubber Co., Ltd. [Ltd.
Ceylon Amalgamated Tea and Rubber Co.,
Ceylon Land and Produce Co., Ltd.
Clunes Estates Company of Ceylon, Ltd.
Cocoawatte (Ceylon) Rubber and Tea Estates, Ltd.
Colombo Commercial Co., Ltd.
Cullen Estates, Ltd.
Dorset Rubber Estate Co., Ltd.
Eila Tea Co., Ltd.
Estates Co., of Uva, Ltd.
Farnham Estate Co., Ltd.
Fernlands Tea Co., Ltd.
Gallabodde Estate Co., of Ceylon, Ltd.
Gallawatte (Ceylon) Rubber Co., Ltd.
Ganapalla Estate Co,, Ltd.
Giragoda Rubber Co., Ltd.
Golinda Tea and Rubber Co., Ltd.
Hantane and Bollagalla Estates Co., Ltd.
Hatbawa Rubber Co., Ltd.
Haydella Tea and Rubber Estates, Ltd.
Hinwerelle Rubber Co., Ltd.
Horawala (Kalutara) Rubber Co,. Ltd.
Hulundawa Rubber and Tea Co., (Ceylon).
Hunuwella (Pelmadulla) Rubber Co., Ltd.
Jambulande Tea and Rubber Estates, Ltd.
Kaluganga Valley Tea & Rubber Co., Ltd.
Kalutara Co., Ltd.
Kalutara Rubber Co., of Ceylon, Ltd.
Kanana Rubber Estate Co., Ltd.
Kandyan Hills Co., Ltd.
Karandupona Estates Co., Ltd.
Katiapola Rubber Co., Ltd.
Kelani Tea Garden Co., Ltd.
Kelani Valley Rubber Co., of Ceylon, Ltd.
Kinnersley (Kalutara) Rubber Co., Ltd.
Kiriella Estate Co., Ltd.
Kuttapitiya Tea and Rubber Co., Ltd.
Lansdowne Rubber Co., Ltd.
Lassahena Rubber Co., Ltd.
L. L. P. Estates, Ltd.
Lipton, Limited.
Lunugala Tea and Rubber Co., Ltd.
Lyegrove Rubber Co., Ltd.
Macaldeniya Tea and Rubber Co., Ltd.
Mahagama Rubber Co., Ltd.
Matale Valley Cocoa and Rubber Co., Ltd.
Meall Mor (Ceylon) Estates, Ltd.
Mocha Tea Co., of Ceylon, Ltd.
Moneragalla Rubber Co., Ltd.
Morakelle Rubber Co., Ltd.
Neuchatel Estates, Ltd.
Niriwatte Co., Ltd.
North Western Rubber Co., Ltd.
Opalgalla Tea and Rubber Estates, Ltd.
Opata Tea and Rubber Co., Ltd.
Panana (Kegalla) Rubber Co., Ltd.
Peacock and Nilambe (Ceylon) Tea and Rubber Estates, Ltd.
Piccadilly (Kelani Valley, Ceylon) Rubber and Tea Estates, Ltd.
Pine Hill Estates Co., Ltd.
Poonagalla Valley (Ceylon) Co., Ltd.
Ragama Tea and Rubber Co., Ltd.
Ratwatte Cocoa Co., Ltd.
Rayigam Co., Ltd.
Ruanwella Tea Co., Ltd.
Rubber Plantations, of Kalutara, Ltd.
Ryan Estates (of Ceylon), Ltd.
Sheldon Estates, Ltd.
Sitawaka Tea and Rubber Co., Ltd.
Sunderland (Ceylon) Rubber Co., Ltd.
Syston Estates Co., of Ceylon, Ltd.
Tannahena Rubber Estates, Ltd.
The Ambalawa Estate Co., of Ceylon, Ltd.
The Damblagolla Rubber Estates, Ltd.
The Diwala (Kegalla) Rubber Co.. Ltd.
The Lagos (Ceylon) Rubber Co., Ltd.
The Walakande Rubber Co., Ltd.
Tillyfour Rubber Co., Ltd.
Udabage Tea and Rubber Co., Ltd.
Udagoda Tea and Rubber Co., Ltd.
Udakelle Rubber Co., Ltd.
Udapolla Rubber Co., Ltd.
Ullswater Rubber Co., of Ceylon, Ltd.
Usk Valley (Kalutara) Rubber Co., Ltd.
Uva Rubber Co., of Ceylon, Ltd.
Vauxhall Rubber Co., Ltd.
Vincit Tea and Rubber Co., Ltd.
Walker, Sons, & Co., Ltd.
Warriapolla Estates Co., Ltd.
Watapota Rubber and Tea Estates, Ltd.
Wellandura Tea and Rubber Co., Ltd.
Weniwella Rubber Co., Ltd.

LOCAL SUBSCRIBERS (INDIVIDUALS.)

E. G. Adamaly & Co., ...	Alavi Estate.
Messrs. D. S. Cameron & G. B. Foote, ...	Bere Ferrers Estate.
C. M. Dias Esq., ...	Gurudola Estate.
C. E. A. Dias Esq., ...	Mukalana and Wawulugala Estates.
The Rt. Hon. Lord Elphinstone, ...	Gikiyanakande Estate.
The Hon. Sir H. Marcus Fernando, ...	Nottinghill Estate.
*The Hon. Mr. C. H. Z. Fernando, ...	Awliscombe & Batakande Estates.
*E. C. de Fonseka Esq., M.B.E. ...	Silverdale Estate.
C. F. Hutchinson Esq., ...	Mapitigama Estate.
Sir H. M. Mallaby-Deely, Bart., ...	Ambanpitiya Estate.
Mackwoods, Ltd., ...	Guava Hill Estate.
Mrs. A. S. Orchard, ...	Ilwana Estate.
Messrs. Wilmot A. and Leslie R. Perera, ...	Hegalla Estate.
S. F. H. Perera Esq., ...	Walahanduwa Estate.
*Lambert L. Pieris Esq., ...	Bibilioyatenne Estate.
*The Hon. Mr. D. S, Senanayake, ...	Narangoda Estate.
*N. D. S. Silva, Esq., ...	Silva Land Estate.
*L. W. A. de Soysa Esq., ...	Paradise and Nugahena Estates.
*R. E. S. de Soysa Esq., ...	Nella Olla Estate.
John H. Starey Esq..	Tudugalla Estate.
A. Sykes Esq.,	Duhallow Estate.

* New Estate for 1928.

APPENDIX No. II.

BULLETINS

No. 1. The Effect of Tapping on the Movements of Plant-Food in Hevea brasiliensis.
„ 2. The Effect of Tapping on the Movements of Plant-Food in Hevea brasiliensis (continued).
„ 3. Seasonal Variations in the Movements of Plant-Food in Hevea brasiliensis, Part I.
„ 4. The Physiological Effects of Various Tapping Systems, Part 1.
„ 5. Progress Report on Vulcanization Tests.
„ 6. The Physiological Effects of Various Tapping Systems, Part II.
„ 7. The Physiological Effects of Various Tapping Systems, Part III.
„ 8. Seasonal Variations in the Movements of Plant-Food in Hevea brasiliensis, Part II.
„ 9. Vulcanization Tests.
„ 10. Vulcanization Tests.
„ 11. Variability in the Rubber Manufacture.
„ 12. Progress Report of the Rubber Research Chemist.
„ 13. Vulcanization Tests.
„ 14. On the variation in the number of Latex Vessels present in Hevea brasiliensis.
„ 15. Vulcanization Tests.
„ 16. On the Natural Clotting of Rubber Latex.
„ 17. Vulcanization Tests.
„ 18. Measurements of "Bark Renewal."
„ 19. Vulcanization Tests.
„ 20. Vulcanization Tests.
„ 21. Vulcanization Tests.
„ 22. Vulcanization Tests.
„ 23. Vulcanization Tests.
„ 24. Vulcanization Tests.
„ 25. Vulcanization Tests.
„ 26. Results of the trials of Ceylon Rubber for the Manufacture of Ebonite.
„ 27. Vulcanization Tests.

„ 28. Vulcanization Tests.
„ 29. Summary of Results of Vulcanization Tests.
„ 30. The Penetration of Disinfectants on the Tapping Cut of Hevea.
„ 31. On the Occurrence of Rust on sheet Rubber.
„ 32. On the " Preservation of Latex."
„ 33. Variability of Plantation Rubber, 1st Interim Report (New Series).
„ 34. Variability of Plantation Rubber, 2nd Interim Report (New Series).
„ 35. Variability of Plantation Rubber, 3rd Interim Report (New Series).
„ 36. Variability of Plantation Rubber, 4th Interim Report (New Series).
„ 37. Variability of Plantation Rubber, 5th Interim Report (New Series).
„ 38. Variability of Plantation Rubber, 6th Interim Report (New Series).
„ 39. Variability of Plantation Rubber, Final Report (New Series).
„ 40. Vulcanizing and Mechanical properties of Wet Rubber.
„ 41. 1st Interim Report on Artificial Ageing Tests on Plantation Rubber.
„ 42. On the Smoking of Sheet Rubber in Relation to Mould Prevention.
„ 43. The Inter-relationship of Yield and the various Vegetative Characters in Hevea brasiliensis.
„ 44. The Construction of Smoke-houses for Small Rubber Estates.
„ 45. The Efficiency of Disinfectants and Fungicides.
„ 46. The Control of Bark Rot by Disinfectants.
„ 47. On the Variability of Ceylon Estate Grades.

APPENDIX No. II —*Contd.*

CIRCULARS.

No.		No.	
1.	Research Work in Ceylon (17-2-21).	13.	First Quarterly Circular for 1925.
2.	Budding and Grafting of Rubber (2-9-21).	14.	Second Quarterly Circular for 1925.
3.	Research Work in Ceylon (5-9-21).	15.	Third Quarterly Circular for 1925.
4.	Scale of Subscriptions (27-2-22).	16.	Fourth Quarterly Circular for 1925.
5.	Research Work in Ceylon (1-7-22).	17.	First Quarterly Circular for 1926.
6.	Rust and Mould on Sheet Rubber.	18.	Second Quarterly Circular for 1926.
7.	Research Work in Ceylon.	19.	Third Quarterly Circular for 1926.
8.	Shipment of Latex.	20.	Fourth Quarterly Circular for 1926.
9.	First Quarterly Circular for 1924.	21.	First Quarterly Circular for 1927.
10.	Second Quarterly Circular for 1924.	22.	Second Quarterly Circular for 1927.
11.	Third Quarterly Circular for 1924.	23.	Third Quarterly Circular for 1927.
12.	Fourth Quarterly Circular for 1924.	24.	Fourth Quarterly Circular for 1927.

On air-dried sheet with the appearance of Smoke Sheet (confidential Circular).

APPENDIX No. III.

SCALE OF SUBSCRIPTIONS.

			£.	s.	d.
No Output	...	... ...	10	10	0
Output up to and not exceeding		100,000 lbs. ...	15	15	0
Exceeding 100,000 lbs. not exceeding		200,000 „ ...	21	0	0
Do	200,000 „ do	300,000 „ ...	26	5	0
Do	300,000 „ do	400,000 „ ...	31	10	0
Do	400,000 „ do	500,000 „ ...	36	15	0
Do	500,000 „ do	600,000 „ ...	42	0	0
Do	600,000 „ do	700,000 „ ...	47	5	0
Do	700,000 „ do	... ...	52	10	0

For Conversion purposes the rate of exchange is the Bank's selling rate for Demand Drafts on London on 15th January or July respectively.

RUBBER RESEARCH SCHEME (Ceylon).

ESTIMATES OF INCOME AND EXPENDITURE

FOR 1928.

REVENUE STATEMENT.

CEYLON.

			Rs.	c.	Rs.	c.
Balance at December 31st, 1928	...	...	129,818	82		
Less Sundry Creditors (approximate)	...	...	4,000	00		
					125,818	82
Income for 1928.						
Government Grant for 1927—28	...	...	67,500	00		
Local Subscriptions 1928	...	...	33,000	00		
Interest on Deposit and Current Accounts		...	3,500	00		
Rent of Culloden Bungalows	...	...	1,645	00		
					105,645	00
			TOTAL	Rs.	231,463	82

LONDON.

				£.	s.	d.
Balance at December 31st, 1928	...	...	...	87	12	10
Income for 1928.						
Contribution from Rubber Growers' Association			...	2,000	0	0
Remittance from Ceylon Committee			...	500	0	0
Interest on balances	...	...	...	40	0	0
			£.	2,627	12	10

EXPENDITURE STATEMENT.

CEYLON.

		Rs.	c.	Rs.	c.
1.	**Personal Emoluments.**				
	(*a*) Salaries and Wages	61,775	00		
	(*b*) House allowances	1,839	00		
				63,614	00
2.	**Laboratory.**				
	(*a*) Chemicals and Laboratory Upkeep	2,000	00		
	(*b*) Samples for Imperial Institute	500	00		
	(*c*) Manuring Experiments	750	00		
	(*d*) Spraying Experiments	100	00		
	(*e*) Factory Experiments	750	00		
	(*f*) Apparatus from London	1,500	00		
				5,600	00
3.	**Buildings.**				
	(*a*) Repairs.	1,500	00		
	(*b*) Insurances.	315	00		
	(*c*) Water Supplies	150	00		
				1,965	00
4.	**Office.**				
	(*a*) Printing, Stationery, Advertising.	2,200	00		
	(*b*) Furniture.	100	00		
	(*c*) Books and Periodicals.	200	00		
				2,500	00
5.	**Travelling.**				
	(*a*) Upkeep of Motor Car.	3,000	00		
	(*b*) Insurance of Car.	130	00		
	(*c*) Subsistence Allowances and Travelling of all Officers.	4,500	00		
	(*d*) Passages from England.	1,600	00		
				9,230	00
6.	**Incidentals.**				
	(*a*) Postages and Telegrams.	1,200	00		
	(*b*) General Charges.	400	00		
	(*c*) Audit and Accountancy.	300	00		
				1,900	00
7.	Sinking Fund for Bonuses and Passages.			10,000	00
8.	Upkeep of Roads.			700	00
9.	**Special Charges.**				
	(*a*) Erection of Store.	200	00		
	(*b*) Alterations to Culloden Bungalow	500	00		
	(*c*) Extension to Laboratory.	5,765	00		
	(*d*) Furniture and Fittings.	1,375	00		
	(*e*) London Expenditure.	5,500	00		
	(*f*) Subordinate Staff Bungalows.	3,000	00	16,340	00
10.	**Experiment Station.**				
	(*a*) Development and Upkeep.	13,000	00		
	(*b*) Building and Upkeep of Road.	5,000	00		
				18,000	00
	TOTAL ... RS.			129,849	00

EXPENDITURE STATEMENT.— Contd.

Summary for Ceylon.

	Rs.	c.
Balance at December 31st, 1927. ...	125,818	82
Estimated Receipts during 1928. ...	105,645	00
	231,463	82
Estimated Expenditure during 1928. ...	129,849	00
Balance at December 31st, 1928. ...	101,614	82

LONDON.

	£.	s.	d.
1. Salaries and Wages	2,119	0	0
2. Postages, Telegrams, and Stationery. ...	50	0	0
3. Gas and Electricity.	115	0	0
4. Apparatus and Chemicals.	120	0	0
5. General Charges.	50	0	0
TOTAL ...	2,454	0	0

Summary for London.

	£.	s.	d.
Balance at December 31st, 1927. ...	87	12	10
Receipts during 1928.	2,540	0	0
	2,627	12	10
Estimated Expenditure during 1928. ...	2,454	0	0
Balance at December 31st, 1928. ...	173	12	10

SINKING FUND FOR BONUSES AND PASSAGES.

	Rs.	c.
Fund at December 31st, 1927.	8,300	00
Payment to Fund during 1928.	10,000	00
Interest during 1928.	620	00
TOTAL ...	18,920	00

Disbursements from Fund during 1928.

Bonus to Mr. R. A. Taylor for leave period. ...	1,200	00
Balance at December 31st, 1928.	17,720	00

These Estimates were considered and approved at the Meeting of the Executive Committee held on December 14th, 1927.

By order,
J. MITCHELL,
Organising Secretary.

RUBBER RESEARCH SCHEME (CEYLON),
PERADENIYA.
2nd February, 1928.